lobes, the body of the samara plainly transverse-rugose and strongly and densely glandular-punctate between the ridges.

Vicinity of Eustis, Florida, June, 1894, *George V. Nash*, according to specimen in U. S. Herbarium. Unlike *P. trifoliata* by its narrow foliage glabrous even when young, and of the same hue on both faces. The samaras also have their marks as unlike those of the northern shrub.

Ptelea mesochora sp. nov.

Foliage of less than half the size of that of *P. trifoliata*, commonly about one-third as large, glabrous or nearly so, very pale and glaucous beneath; odd leaflet 2 or 3 inches long, rhombic-ovate, merely acute, not acuminate or even cuspidate, the laterals rather more than half as large, more or less inequilateral: samaras of the largest, commonly 1 inch long, round-obovate or even slightly obcordate, truncate or subcordate at base, the very broad wing apt to be full and wavy, strongly reticulate, the body oval, small in proportion, excentric, nearer the summit than the base, distinctly rugose, the intervals rather closely punctate.

Of the region of the upper Mississippi valley and vicinity of Lake Michigan; the best specimens by *Umbach*, from Miller's, Indiana, 30 July, 1897; Canton, Ill., 1875, *J. Wolfe*; Oquawka, Ill., *Patterson*, 1874. Distinct from *P. trifoliata* by its much smaller foliage and even larger fruits.

CYTOLOGICAL DIFFERENCES BETWEEN THE PALMELLA AND FILAMENTOUS FORMS OF STIGEOCLONEUM

By Naohidé Yatsu

It has long been known that *Stigeoclonium* takes two different forms according to environmental conditions. In dry atmosphere the alga is spherical and is known as the palmella form, while in a wet place it becomes filamentous. Four years ago, Dr. B. E. Livingston * succeeded in changing one form into the other simply by transferring the alga from one culture solution to another of different strength. At the suggestion of Dr. Mac-

* Livingston, B. E. On the stimulus which causes the change of form in polymorphic green algae. Bot. Gaz. 30: 289–361. 1900.

Dougal I undertook the cytological study of the two forms of *Stigeoclonium*. Owing to the minuteness of the cells, I could not satisfactorily carry out the study, yet I think I obtained a few points of interest. I am under great obligation to Dr. MacDougal for his kindly suggestions and criticisms, and also to Dr. Livingston, who not only has put some of his materials and solutions at my disposal, but also has given me much invaluable information.

I. Methods

Both the palmella and filamentous forms were examined in the living state. Especially was the transformation from one form to the other carefully studied. After several fixing fluids had been tried, I found that Boveri's picro-acetic acid proved better than any other. This, therefore, was used almost exclusively. All the preparations were stained *in toto* with borax-carmine; the sections were stained either with Auerbach's fluid (mixture of methyl green and fuchsin S) or with iron-alum-haematoxylin. To make total preparations of the filament, the following method was used. A clean cover-glass was touched on the surface of the water in a culture dish, where the filaments were floating. Then the cover-glass was dipped in the fixing fluid, which killed and fastened the algae at the same time. To obtain the total preparations of very young filaments, a drop of weaker solution was put on a cover-glass and a few palmella cells were kept in this drop for a week or so until the young filaments reached the two- or three-celled stage. Then all the solution was drawn off by means of filter paper, and the cover-glass was put in fixing fluid, which, as already stated, fixed and fastened the algae. To cut filaments into sections the following devices were used. A piece of *Ulva*, which had been preserved in alcohol, was washed with water and was fastened with albumen on a cover-glass. Then the *Ulva* was touched to the surface where filaments were floating and the cover-glass with the *Ulva* was put in the fixing fluid. After being clarified, the *Ulva* pieces with algae were peeled off from the cover-glass and cut into sections. The palmella cells were wrapped up in frog's epidermis to be cut.

II. Observations

A. *Filamentous Form.* — In the filamentous form, individual cells are cylindrical, two or three times as long as wide. The cell wall is very thin; the protoplasm spreads along the cell wall as a thin layer, the central part being occupied by a large vacuole. On one side there is a thickening of protoplasm, which sometimes reaches the other side, so that the central vacuole is cut into two. The terminal cell is somewhat different from others; it is usually longer than the rest of the cells and tapers toward the tip. The terminal cell has protoplasm of uniform thickness along all the walls. The central vacuole in it reaches the tip of the cell as a fine canal.

Fig. 1. Filament of *Stigeoclonium*, showing transformation from the palmella form (two lower cells) to the filamentous form (three upper cells), × 1,750. The dark bodies represent the nuclei; the lighter, the pyrenoids.

Chlorophyll granules of small size are found throughout the protoplasm.

The nucleus as a rule lies in the thickening of protoplasm just mentioned. It is difficult to see the nucleus in life. When stained it appears as a homogeneous black body. It consists mostly of chromatin. The presence of the nuclear membrane is in no way demonstrable.

Besides the nucleus there is a refringent pyrenoid body embedded in protoplasm. The position of this is not fixed; sometimes it is found near the nucleus, while in other cases it lies on the side opposite to the nucleus. Quite often it is surrounded by a clear space. In borax-carmine preparations on the other hand, it remains colorless or very light red, the nucleus being stained dark red. In cell-division it divides into two in a way not unlike the nucleus.

The first filament from the spore contains much protoplasm resembling that of the palmella form. The vacuole develops later. At the two-celled stage the terminal cell can be distinguished from the other cells. The branches can be sent off from any cell, the tranverse division taking place only at the tip.

B. *Palmella Form.* — The palmella cells are spherical, or quite often two, three or four cells make a sphere. The walls are thick compared with those of the filament. No vacuoles are found in the protoplasm. The chlorophyll granules are much larger than those found in the filament. In size and other characters of the nucleus one cannot find any difference between the two forms. Palmella cells have much larger pyrenoids than the filaments.

The palmella cells can be directly transformed into the filament by thinning of the walls, acquiring of the vacuoles, etc. In several cases, therefore, the intermediate forms are found.

The palmella form, being put into the weaker solution, usually produces zoöspores, two or four in a cell or sometimes as many as eight. The zoöspore has two flagella and a red eye-spot. The spores after swimming for a while acquire a firm wall or shell. Young filaments, even as late as the three-celled stage, often carry the empty shell at one end.

III. Conclusion

Recapitulating the differences : the filamentous form of *Stigeoclonium* has thinner wall, central vacuole, smaller chlorophyll granules, and smaller pyrenoids, whereas the opposite prevails in the palmella cells. These cytological characters change, as Livingston states, if one form is transferred from one solution into another of different strength. How the solution acts upon the cells I do not know. It is however certain that these complicated structural changes cannot be accounted for simply as physico-chemical action of the solution just as would be the case on an inorganic body. Livingston cites a case in which a dead cell changed its form, when transferred into a solution of different strength. The form change which constitutes a part of the above complicated modification may be due to the osmotic action, but we cannot at all explain from physical point of view how the thickening of the cell-wall, enlargement of the pyrenoid, etc., are brought about.

It is not an easy matter to find out whether or not the adaptation in this case is purposive. It seems to me however, that the increase of the thickness of cell wall and the enlargement of the pyrenoid (reservoir of nutritive substance) may be indispensable to withstand desiccation or a drier atmosphere.

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FLOWERING OF YUCCA AUSTRALIS

By S. B. Parish

In 1878, the late Dr. C. C. Parry collected, in northern Mexico, seeds of a remarkable tree Yucca, which he had not been able to identify with any described species. On his next visit to California, in 1880, he gave some of these seeds to the writer. They germinated readily and the young plants were distributed to several friends in San Bernardino valley. They have grown well and have now attained a height of fifteen to twenty five feet, according to cultural conditions. Five years ago, the first of them flowered, producing, on a short, abruptly reflexed peduncle, a massive, compact panicle of pure white flowers, very much resembling in texture and shape the flowers of *Yucca mohavensis*, one of the common indigenous species of this region. It was readily recognized as that species of many synonyms, to which Trelease has given the name *Yucca australis* (Engelm.), perhaps the most distinct of the whole genus.

After flowering, this tree, which, like the others, was unbranched, divided into four short branches, and in the spring of the present year three of these produced each its panicle of flowers. It is shown by the illustration, which is reproduced from a photograph.

The tree is strikingly beautiful when in flower, far handsomer than it appears in the plate in Trelease's Yucceae, which is from a photograph taken in its native habitat in Mexico. Our trees have produced no fruit, doubtless by reason of the absence of the proper *Pronuba*. *Yucca australis* was introduced into the gardens of southern France about 1860, from seed collected by Roezl, the first tree flowering in its sixteenth year, and is there known under a variety of names. In the United States, the San Bernardino trees are probably the only flowering specimens, but it is well worth cultivation wherever the climate is suitable.

San Bernardino, California.